

What is claimed is:

1. An image interpolating method comprising:
a step (a) of searching an edge direction to be used for
interpolation by a pixel matching using input pixels; and
a step (b) of generating a pixel to be substantially
interpolated by referring to pixels located on the searched
edge direction.
2. The method of claim 1, wherein the step (a) determines
the edge direction as 0° direction at a flat region
having a less variation of a signal and a texture part
having a severe variation of the signal.
3. The method of claim 1, wherein the step (a) measures an
error of each of the edge directions using a measurement
function and determines a direction having a minimum
error value of the errors as a final edge direction.
4. The method of claim 1, wherein the step (a) determines
the edge direction (edge_direction) using a following
formula:

$$edge_direction = \begin{cases} \arg \min\{mae_{-45^\circ}, \gamma \times mae_{0^\circ}, mae_{45^\circ}\}, & \text{when } \min_error < T \\ 0^\circ, & \text{otherwise} \end{cases}$$

, where $\min_error = \min\{mae_{-45^\circ}, \gamma \times mae_{0^\circ}, mae_{45^\circ}\}$, T is a threshold value, and $0 < \gamma < 1$.

5 5. The method of claim 1, wherein the step (a) searches the edge direction having a minimum error by matching pixels located at upper and lower lines of a pixel to be interpolated for a vertical interpolation.

10 6. The method of claim 5, wherein the step (a) outputs a relative horizontal coordinate as a result of a vertical pixel matching in accordance with the searched edge direction.

15 7. The method of claim 1, wherein the step (b) interpolates an input image twice in a vertical direction using a following formula:

$$\hat{f}(m, n') = \begin{cases} f(m, \frac{n'}{2}), & \text{when } n' \text{ is even number} \\ \left[f(m + d_x, \frac{n'-1}{2}) + f(m - d_x, \frac{n'+1}{2}) \right] / 2, & \text{when } n' \text{ is odd number} \end{cases}$$

20 where n is an index representing a location of each pixel before interpolation, and n' is an index

representing a location of each pixel interpolated in a vertical direction.

- 5 8. The method of claim 1, wherein the step (a) searches the edge direction having a minimum error by matching pixels located at right and left to a pixel to be interpolated for a horizontal interpolation.
- 10 9. The method of claim 8, wherein the step (a) outputs a relative vertical coordinate as a result of a horizontal pixel matching in accordance with the searched edge direction.
- 15 10. The method of claim 1, wherein the edge-directed search and interpolation in the steps (a) and (b) are carried out independently in vertical and horizontal directions, respectively.
- 20 11. The method of claim 1, the step (b), when an input image is interpolated into various multiples, and when a crossing location between the extended line along the determined edge direction from the location of the pixel to be substantially interpolated and horizontal (vertical) line in case of vertical (horizontal)

interpolation fails to coincide with a location of an original sample, comprising the steps of:

preparing an interpolation pixel in a horizontal direction by referring to a plurality of pixels adjacent to the crossing in the same edge direction; and
preparing the pixel to be substantially interpolated by referring to the horizontal interpolation pixel.

12. An image interpolating apparatus comprising:

a vertical interpolation unit searching an edge direction for a vertical direction by a pixel matching using input pixels and carrying out a vertical interpolation filtering in the searched edge direction; and

a horizontal interpolation unit searching an edge direction for a horizontal direction by the pixel matching using the input pixels and carrying out a horizontal interpolation filtering in the searched edge direction,

wherein the vertical and horizontal interpolation units have structures independent from each other.

13. The apparatus of claim 12, the vertical interpolation unit comprising:

a vertical pixel matching unit determining the edge direction having a minimum error by matching pixels located

at upper and lower lines of a pixel to be interpolated using a measurement function and outputting a relative horizontal coordinate as a result of a vertical pixel matching in accordance with the determined edge direction; and

a vertical interpolation filter unit carrying out an interpolation in a vertical direction using the input pixels, 1-line-delayed pixel, and pixels located at the relative horizontal coordinate of the vertical pixel matching unit.

14. The apparatus of claim 12, the horizontal interpolation unit comprising:

a horizontal pixel matching unit determining the edge direction having a minimum error by matching pixels located at right and left to a pixel to be interpolated using a measurement function and outputting a relative vertical coordinate as a result of a horizontal pixel matching in accordance with the determined edge direction; and

a horizontal interpolation filter unit carrying out an interpolation in a horizontal direction using the input pixels, a plurality of pixels delayed sequentially by line units respectively through a plurality of line memories,

and pixels located at the relative vertical coordinate of the horizontal pixel matching unit.

15. An image interpolating method comprising:

5 a step (a) of carrying out a first interpolation on input pixels using linear interpolation; and
a step (b) of finding a weighted value coefficient in accordance with a relationship between the first interpolated pixel and the adjacent input pixels to be used for interpolation and preparing a pixel to be substantially interpolated by adaptive weighted interpolation applying the found weighted value coefficient to the adjacent input pixels.

15 16. The method of claim 15, wherein the step (a) carries out the first interpolation on the input pixels using bi-linear interpolation.

20 17. The method of claim 15, wherein the step (b) carries out the interpolation using a following formula when the first interpolated pixel is distant from a reference pixel as far as α ($\alpha \neq 0$) in a horizontal direction and β ($\beta \neq 0$) in a vertical direction:

$$g(m', n') = w_{11} \cdot f(m, n) + w_{12} \cdot f(m+1, n) + w_{21} \cdot f(m, n+1) + w_{22} \cdot f(m+1, n+1),$$

$$\text{where } w_{11} = \frac{C}{\left\{f(m, n) - \hat{g}(m', n')\right\}^2 + \varepsilon^2}, \quad w_{12} = \frac{C}{\left\{f(m+1, n) - \hat{g}(m', n')\right\}^2 + \varepsilon^2},$$

$$w_{21} = \frac{C}{\left\{f(m, n+1) - \hat{g}(m', n')\right\}^2 + \varepsilon^2}, \quad w_{22} = \frac{C}{\left\{f(m+1, n+1) - \hat{g}(m', n')\right\}^2 + \varepsilon^2}, \quad \varepsilon^2$$

relates to a distribution of a noise, C is a normalization constant, $f(m, n)$ is the input pixel located at a left-upper part of the pixel to be interpolated as a reference, $f(m+1, n)$ is the input pixel located at a tight-upper part of the pixel to be interpolated, $f(m, n+1)$ is the input pixel located at a left-lower part of the pixel to be interpolated, $f(m+1, n+1)$ is the input pixel located at a right-lower part of the pixel to be interpolated, and $\hat{g}(m', n')$ is a first linearly-interpolated pixel.

18. The method of claim 17, wherein the step (b) carries out the interpolation using a following formula when the first interpolated pixel is distant from the input pixel as the reference pixel as far as $\beta (\beta \neq 0)$ in a vertical direction:

$$g(m', n') = w_{11} \cdot f(m, n) + w_{21} \cdot f(m, n+1), \text{ where}$$

$$w_{11} = \frac{C}{\left\{f(m, n) - \hat{g}(m', n')\right\}^2 + \varepsilon^2} \text{ and } w_{21} = \frac{C}{\left\{f(m, n+1) - \hat{g}(m', n')\right\}^2 + \varepsilon^2}.$$

19. The method of claim 18, wherein the step (b) carries out the interpolation using a following formula when the first interpolated pixel is distant from the input pixel as the reference pixel as far as $\alpha(\alpha \neq 0)$ in a horizontal direction:

$g(m', n') = w_{11} \cdot f(m, n) + w_{12} \cdot f(m+1, n)$, where

$$w_{11} = \frac{C}{\left\{ f(m, n) - \hat{g}(m', n') \right\}^2 + \varepsilon^2} \quad \text{and} \quad w_{12} = \frac{C}{\left\{ f(m+1, n) - \hat{g}(m', n') \right\}^2 + \varepsilon^2}.$$

20. An image interpolating apparatus comprising:

a linear interpolation unit carrying out a first interpolation on input pixels; and

an adaptive weighted interpolation unit finding a weighted value coefficient in accordance with a relationship between the first interpolated pixel of the linear interpolation unit and the adjacent input pixels used for interpolation and preparing a pixel to be substantially interpolated by adaptive weighted interpolation applying the found weighted value coefficient to the adjacent input pixels.